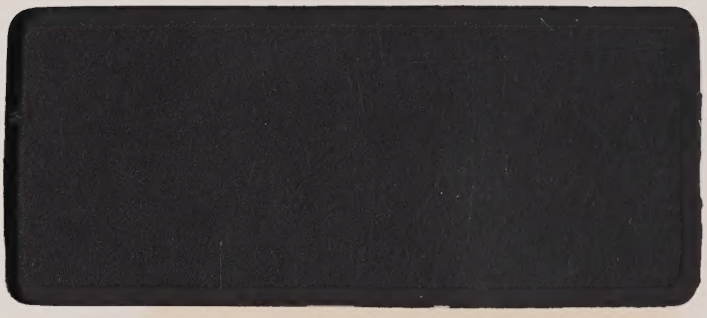
GEN RESISTANCE RDS SERIES
INSTRUCTION MANUAL

RDS SERIES

INSTRUCTION / OPERATION MANUAL



RDS SERIES

INSTRUCTION / OPERATION MANUAL

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LIMITED WARRANTY

General Resistance Div. warrants each instrument to be free from defects in material and workmanship for a period of one year from date of purchase.

The obligation of General Resistance Div. under this Warranty is limited solely to servicing or adjusting any failed instrument returned, shipped prepaid, to the factory for that purpose.

Units returned under this Warranty shall be examined by General Resistance Div. to establish that the failure resulted from defective material and/or workmanship and not as a result of misuse, neglect, or improper operation, which latter failure is not within the meaning of this Warranty.

This Warranty does not cover collateral or consequential damages of any nature, type or description, whether resulting from express warranties, implied warranties or negligence.

General Resistance Div. reserves the right to make changes to design at any time without incurring any obligation to install same in units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of General Resistance Div., express or implied, and General Resistance Div. neither assumes nor authorizes any person to assume for them any other liability in connection with the sale of General Resistance Div. products.

Section 1

INTRODUCTION

1.1 Description

The General Resistance RDS4_, 5_, 6_ and 7_ are the same except for the number of decades and the decade values.

These instruments are resistance standards for field and laboratory resistance calibrations. Its rugged construction employs high reliability encapsulated wirewound resistors with very low, matched temperature coefficients. Their high stability assures specified performance even after years of continuous use. All switches employed are high quality and use solid silver contacts for low, unvarying, contact resistance and long life. All insulation is of the highest grade to give extremely high leakage resistances under adverse temperature and humidity conditions.

Figure 1 is an outline drawing of the instrument. The terminals are accessible on the left side of the front panel. A case (ground) terminal as well as high and low inputs are provided. Decade dials are used to set the desired resistance value. The value is conveniently read from the in-line numerals.

1.2 Schematic

Figure 2 shows the schematic of a six decade resistance box. Please note that all schematics are identical except for the number of decades. Each decade uses ten equal, matched resistors which are wired in series and sequentially unshorted as the switch contact is rotated from zero to maximum resistance. The separate decades are all wired in series across the input terminals. All decades are floating with respect to the case. The LOW terminal can ge grounded to the case, if desired.

1.3 Specifications

Number of decades: Four, Five, Six or Seven

Resistance range:

TABLE I

Model	No. of Decades	Total Resistance Ohms	Ohm/Step Highest Decade	Ohms/Step Lowest Decade	Max. Zero Resistance Ohms
RDS41	4	111.1	10	.01	0.006
RDS42	4	1.111K	100	0.1	0.006
RDS43	4	11.11K	1K	1	0.006
RDS44	4	111.1K	10K	10	0.006
RDS45	4	1.111 Meg	100K	100	0.006
RDS52	5	1.1111K	100	.01	0.0075
RDS53	5	11.111K	1K	0.1	0.0075
RDS54	5	111.11K	10K	1	0.0075
RDS55	5	1.1111 Meg	100K	10	0.0075
RDS56	5	11.111 Meg	1 Meg	100	0.0075
RDS63	6	11.1111K	1K	.01	0.009
RDS64	6	111.111K	10K	0.1	0.009
RDS65	6	1.11111 Meg	100K	1	0.009
RDS66	6	11.1111 Meg	1 Meg	10	0.009
RDS74	7	111.1111K	10K	.01	0.0105
RDS75	7	1.111111 Meg	100K	0.1	0.0105
RDS76	7	11.11111 Meg	1 Meg	1	0.0105

Temperature Coefficient: +/-20 ppm/Deg C max

Resistance accuracy (at 25 Deg C after subtraction zero resistance): See Table II

Wattage rating of individual resistors: See Table II

Maximum current/decade (mA): See Table II

Stability: 25 ppm/yr, 100 ohm decade up
100 ppm/yr, 10 ohm decade
0.05%/yr, 1 ohm decade
0.1%/yr, .1 and .01 ohm decade

Size: See Figure 1

Weight: Six (6) pounds

Specifications (continued)

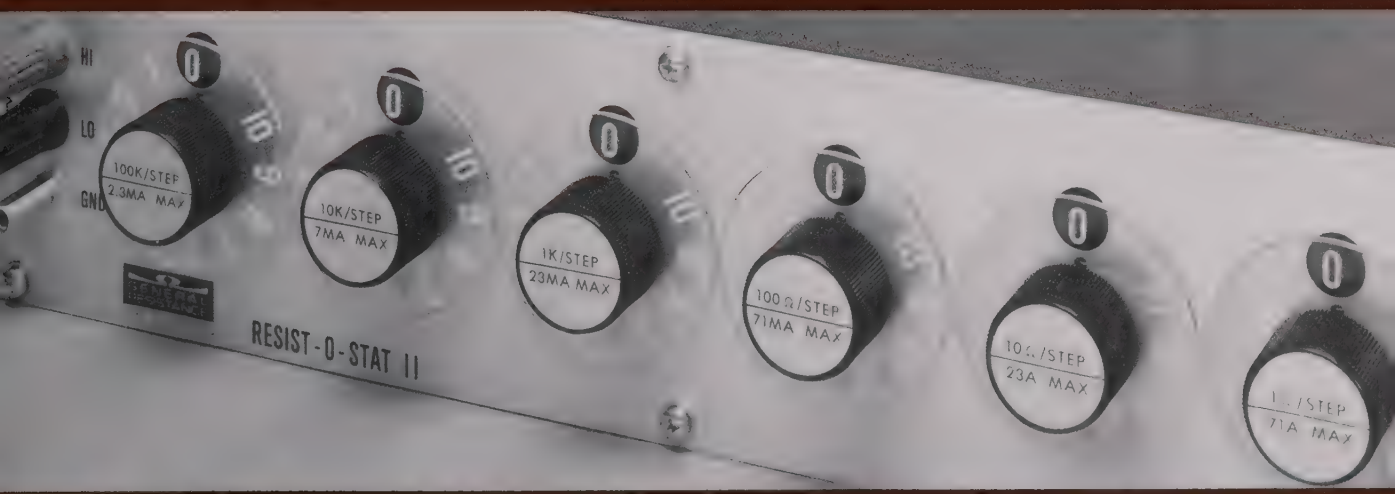
TABLE II

Ohm/Step	
0.01	
0.1	***ALL SPECIFICATIONS ARE PER
1	LATEST GENERAL RESISTANCE
10	DATA SHEET FOR RDS SERIES
100	RESISTANCE DECADES -
1K	BULLETIN GR104***
10K	
100K	
1 Meg	

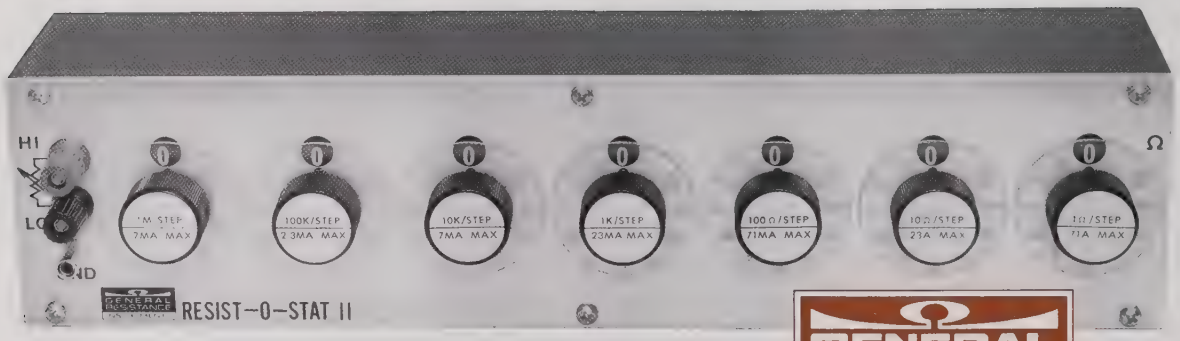
GENERAL RESISTANCE

RESISTANCE DECADES

Universal resistance decade boxes engineered for high accuracy and long life in the laboratory or on the production line. Many models suitable for RTD simulation.



Innovators and manufacturers of ultra-precision test instruments used as laboratory standards and for critical process monitoring.



GENERAL RESISTANCE

Resistance Decades

Precision instruments in a choice of two fine series to make it possible to specify one unit that meets both application requirements and cost requirements.

Both the RDS Series and the DA Series are General Resistance quality instruments based upon the GR ultra-precision wirewound resistor that the company has been producing for almost 30 years, offering 111.111 megohm resistance values, accuracies to ±0.01%, resolutions to 0.01Ω and models of up to 7 decades. The technical differences between the two series are capsuled in the table below.

COMPARATIVE FEATURES

RDS SERIES	DA SERIES
○ Accuracies .01% or 0.025%	○ Accuracies .01, 0.1 or 1.0%.
○ 4, 5, 6 or 7 decades.	○ 3, 4, 5, 6, or 7 decades.
○ "Top of the line" GR performance.	○ Less than one-half the cost of RDS units.
○ Rotary switches, gold-plated contacts, low contact R.	○ Easy-to-use, economical thumbwheel switches.
○ OEM models available on special order.	○ Three mechanical configurations.

Resist-O-Stat models (RDS Series) are available in two versions —with basic accuracies of either ±0.025% or ±0.01%. Resistors used are low reactance types permitting the RDS to be used from dc through audio frequencies. Zero resistance is 0.0015Ω /decade. Numerical readout is positive and in-line. Switches are low noise "thermal-free" types with self-cleaning contacts.

Dial-An-Ohm units (DA Series) provide reliable performance at less than one-half the cost of the RDS models, partly because DA thumbwheel switches are far less expensive than RDS rotary switches. As can be seen under "How to Order" on back page, the DA Series offers a choice of three mechanical configurations — a bench-top model and two OEM versions.

Model E-35B Instant Lab. It should be noted the General Resistance Model E-35B can also be used as a resistance decade box. This versatile multi-purpose instrument also performs as a T/C and RTD simulator and as a voltage current source ... all with ±0.1% accuracy. (See back page.)

SPECIFICATIONS

Table I

	RESIST-O-STAT (RDS)	DIAL-AN-OHM (DA) High Accuracy ("X" Version)	DIAL-AN-OHM (DA) Basic Model	DIAL-AN-OHM (DA) Economy ("N" Version)	E-35B (R Decade Mode)
Resistance Range	← Depends on Model Selected. See Table II →				0.2111Ω
Resolution	← Depends on Model Selected. See Table II →				0.1Ω
Accuracy of setting (deviation from "zero" resistance)	Suffix A: ±(.01% + .0015Ω) Suffix B: ±(.025% + .004Ω)	±(.01% + .010Ω)	±(.1% + .015Ω)	±(1% + .030Ω)	±(.1% + .025mΩ)
"Zero" resistance, Ω/decade	0.0015 max.	← 0.015 typ./0.025 max. →			0.040
Resistor tempco ±ppm/°C) 10Ω and below	15	10 typ./20 max.	10 typ./20 max.	60 typ./100 max.	10 typ./20 max.
Resistor tempco ±ppm/°C) 100Ω and above	5	3 typ./5 max.	3 typ./5 max.		3 typ./5 max.
Resistor stability (±ppm) 24 hours	—	10 max.	10 max.	100 max.	10 max.
Resistor stability (±ppm) 1 year	25	35 max.	35 max.		35 max.
Resistor power coefficient/watt (±ppm)	500 (10Ω and below) 200 (100Ω and above)	225	450	500	450
Resistor power rating, watts (max.)	0.5 @ 125°C	0.2	0.33	0.5	0.33
Switch life rating, operations	>100,000	← >50,000 →			
Breakdown voltage, (Vrms max.)	1500	← 750 →			
Decade voltage limits	← 300 VDC max./resistor →				
Dimensions (H × W × D) — in. (mm)	4 × 17 × 3⅛ (102 × 432 × 79)	← See back page →			

GR Decade Boxes as RTD Simulators

All the RDS and DA models listed below perform effectively as RTD Simulators.

RDS-41, 42, 43, 52, 53, 63, 64, 74, 75
DA-31, 32, 33, 42, 43, 52, 53, 63, 64, 74, 75

Review of Tables I and II will permit you to establish the model that is right for your application. Choice of model must be made on the basis of accuracy and resolution. There is a GR box for virtually *any* RTD system.

NOTE: When the ultimate in accuracy is required, it is strongly recommended that the General Resistance RTD-100X or RTD-100 RTD Simulator be used. These two units bear all-inclusive "no adder" accuracy statements of ±0.005% and ±0.01% respectively.

All resistance decades are limited in effectiveness when used as RTD simulators because of *"O" resistance.* The accuracy of *any* resistance box is quoted as a deviation from "O" resistance. And, while this phenomenon *can* be compensated for, it will *not* be compensated for in most cases. "O" resistance, accordingly, can contribute significantly to the inaccuracy of simulation or calibration in an RTD application *and is usually the largest contributor to such inaccuracy.* (For example: Model RDS-52A with ±0.01% basic accuracy can be off by as much as ±0.19% at a setting of 100 because of "O" resistance and contact resistance effects.)

RESISTANCE RANGES

Table II

MODELS		Number of Decades	Ω/Step LSD (Resolution)	Ω/Step MSD	RESISTANCE RANGE (Ω) Min. Setting	RESISTANCE RANGE (Ω) Max. Setting
	DA-31	3	0.1	10	0	111.0
	DA-32	3	1	100	0	1,110.0
	DA-33	3	10	1K	0	11,100.0
	DA-34	3	100	10K	0	110,000.0
	DA-35	3	1K	100K	0	1,110,000.0
	DA-36	3	10K	1 MEG	0	11,100,000.0
RDS-41		4	0.01	10	0	111.1
RDS-42	DA-42	4	0.1	100	0	1,111.0
RDS-43	DA-43	4	1	1K	0	11,110.0
RDS-44	DA-44	4	10	10K	0	111,100.0
RDS-45	DA-45	4	100	100K	0	1,111,000.0
RDS-46	DA-46	4	1K	1 MEG	0	11,110,000.0
RDS-52	DA-52	5	0.01	100	0	1,111.1
RDS-53	DA-53	5	0.1	1K	0	11,111.0
RDS-54	DA-54	5	1	10K	0	111,110.0
RDS-55	DA-55	5	10	100K	0	1,111,100.0
RDS-56	DA-56	5	100	1 MEG	0	11,111,000.0
RDS-63	DA-63	6	0.01	1K	0	11,111.1
RDS-64	DA-64	6	0.1	10K	0	111,111.0
RDS-65	DA-65	6	1	100K	0	1,111,110.0
RDS-66	DA-66	6	10	1 MEG	0	11,111,100.0
RDS-67		6	100	10 MEG	0	111,111,000.0
RDS-74	DA-74	7	0.01	10K	0	111,111.1
RDS-75	DA-75	7	0.1	100K	0	1,111,111.0
RDS-76	DA-76	7	1	1 MEG	0	11,111,110.0
RDS-77		7	10	10 MEG	0	111,111,100.0

HOW TO ORDER

Resist-O-Stat

Specify Basic Model / Specify Accuracy

RDS-41 A
RDS-41 B

Dial-An-Ohm

Specify Configuration
Specify Basic Model / Specify Accuracy

DA-31 - 1 X

RESIST-O-STAT DIRECTIONS:

Select basic model number from Table II. First half of number identifies number of decades, second half of number indicates power of 10 of most significant digit (10^3 = 1000Ω/step.)

Select accuracy: Suffix "A": ±0.01% Suffix "B": ±0.025%

DIAL-AN-OHM DIRECTIONS:

Select model number from Table II. First half of number = number of decades, second half = power of 10 of most significant digit (10^3 = 1000Ω/step).

Assign number of mechanical configuration desired:
−1 = Open back unit for OEM panel-mounting.
−2 = Enclosed unit for panels, test consoles, etc.
−3 = Cabinet model for bench-top use.

Specify accuracy (special model):

Suffix "X" (high accuracy model)	:	.01%
Suffix "N" (economy model)	:	1.0%
No Suffix Letter (basic model)	:	0.1%

DIMENSIONS: DIAL-AN-OHM SERIES

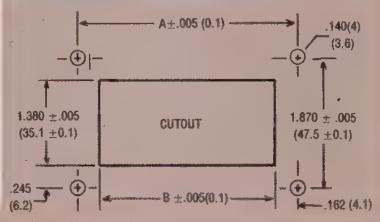
All dimensions — inches (mm)

	Dimensions (high × wide × deep)
Configuration −1:	2¼ × 2⅝ × 2⅞ (57 × 67 ×73)
	Add for each additional decade: ½(13)
Configuration −2:	2½ × 2⅞ × 4⅝ (64 × 73 × 118)
	Add for each additional decade: ½(13)
Configuration −3:	3 X 5 ¼ X 4 ⅛ * (76 X 133 X 105)*

Note: Above dimensions for 3 decade unit.
*Dimensions exclusive of binding posts, feet and screwheads.

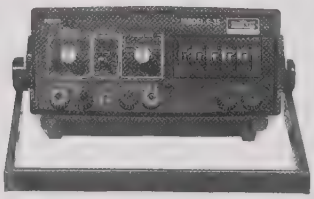
Decades	A	B
3	2.225 (56.5)	1.900 (48.3)
4	2.720 (69.1)	2.395 (60.8)
5	3.215 (81.7)	2.890 (73.4)
6	3.710 (94.2)	3.385 (86.0)
7	4.205 (106.8)	3.880 (98.6)

PANEL CUTOUT INFORMATION FOR "−1" & "−2"



"Instant Lab" E-35B

The 5-in-1 battery-operated calibrator and E/I/R source



Model E-35B performs effectively as a decade resistance box. It also simulates the output of thermocouples B, E, J, K, N, R, S and T, as well as any RTD with resistances from 0 to 2000Ω —10Ω copper, 120Ω nickel, and 100, 500 and 1000Ω platinum. As a voltage/current source, it outputs 0-200 mVDC, 0-20 VDC and 0-200 mADC. Basic accuracy for all functions is ±0.1% of setting with readout provided in a simple in-line easy-to-read format. The instrument is ideal for all-purpose use in R&D labs, as well as for in-house calibration, production testing and field applications. It is portable, battery-operated, inexpensive and easy-to-operate with instructions mounted on top of case. The unit is a lightweight 5 lbs. (2.3 kg) and 4 × 10 × 11 inches (102 × 254 × 280) in size. A line only version (Model E-35) is also available.

For further information:

For additional detail on products, options or special orders, call and ask for Customer Service.

(203) 481-5721
TWX: 710-452-3092
FAX: 203-481-8937

Or, if you prefer, write to the address at bottom of page.

Product Data Bulletins from GR:

GR-101 — Thermocouple Simulators
GR-102 — RTD Simulators
GR-103 — Voltage/Current Sources
GR-104 — Resistance Decades
GR-105 — Specialized Instrumentation

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GENERAL RESISTANCE

GENERAL RESISTANCE

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Section 2

OPERATION

2.1 General

The operation of these instruments is straight forward. The resistance set between the HIGH and LOW front panel terminals is the sum of the values set on each decade dial, without recourse to any multipliers, in series with a zero resistance which is less than 10.5 milliohms. The selected resistance is easily read on the in-line display.

2.2 Power Limitations

The resistors have a (maximum) power rating at an ambient temperature of 25 Deg C. The maximum allowable current at this ambient, for each decade is per Table II. Because all decades are in series, if more than one decade is in use (set to a value other than zero), the maximum allowable current is the value given for the highest resistance decade used.

2.3 Calibration

Each instrument is warranteed to perform within the specifications of Section 1.3, without recalibration or readjustment, for a period of 1 year.

Section 3

CALIBRATION

Although the instruments are highly stable devices, periodic calibration permits accuracy improvement by taking advantage of the instrument's short term stability. For ultimate accuracy, the decade resistance box should be calibrated at the voltage and temperature conditions of actual usage.

3.1 Equipment Required

a) A Wheatstone bridge, calibrated to an accuracy of a few parts per million (General Resistance Model 6003E, Model PWB-6000, or equal).

b) A constant current supply capable of delivering 10 milliamps DC to a 100 ohm load, with an accuracy of a few parts per million (General Resistance Model DAS-56).

c) A voltage calibrator, with an accuracy and stability of a few parts per million, capable of an open circuit output of 0-1 volts DC and resolution of 1 ppm (General Resistance Model DAV-46 or equal).

d) A high impedance (1 megohm or greater) null detector or microvolt meter with a sensitivity of better than 10 microvolts.

3.2 Procedure for Measurement of Zero Resistance

The first step in the calibration is the determination of the zero resistance of the decade resistance box under test. The preferred method is to set all decades to zero, cause an accurately known current (10mA DC is suggested) to flow through the instrument under test, and measuring the ensuing voltage drop across the input terminals. The zero resistance is then calculated from the ratio of the measured voltage drop to the applied current (10mA). The zero correction is normally very small, unless the decade resistance box is used for very low resistance settings, so that this zero resistance measurement need not be made to high accuracy. However, the same test setup used for calibration of the low ohm decades can be used with very good accuracy. In many applications knowledge of the zero resistance is not required, and incremental accuracy is more important.

3.3 Decade Calibration

After the zero resistance of the box is measured, all decades can be calibrated. Low value decades (below 100 ohms) are best calibrated by the method described in the preceding paragraph. Figure 3 shows the recommended connection of the calibration equipment. The constant current supply forces an accurately known 10mA DC through the decade under test. The voltage drop at the instrument terminals is read with high precision by nulling the sensitive meter with an acurately calibrated, high resolution voltage source. The cumulative resistance set on the instrument under test is then calculated as the ratio of the voltage drop, as read from the nulling reference voltage source to the 10mA current from the constant current supply. The incremental value of any step can be determined by subtration of the cumulative value before and after insertion of the step.

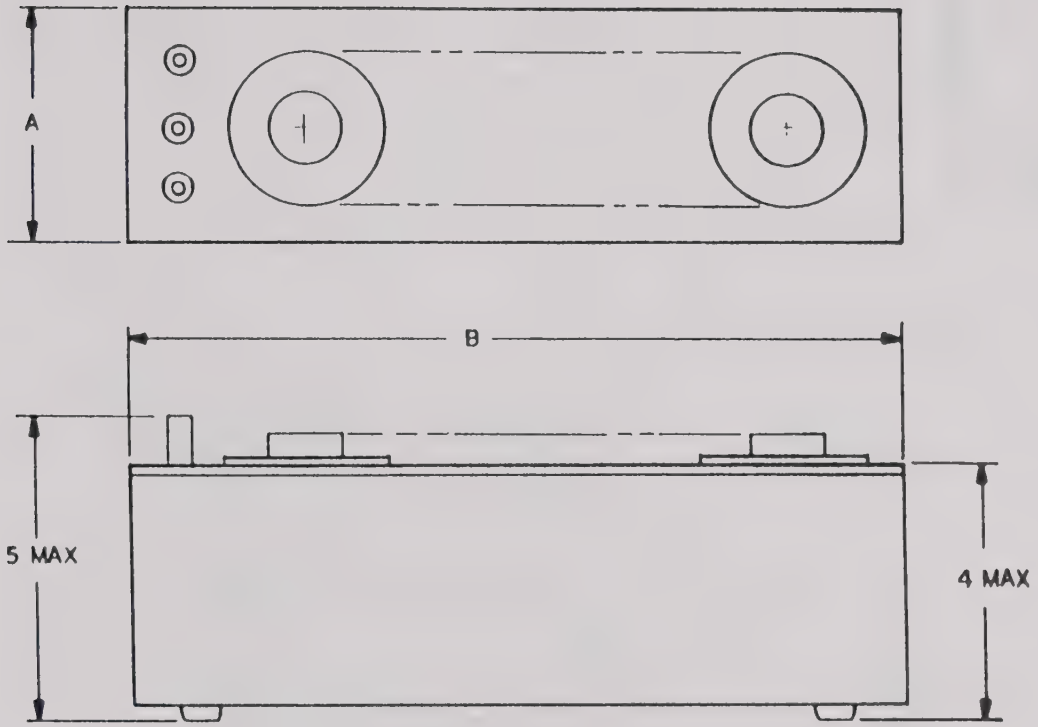
Calibration of the decades having steps of 100 ohms and greater is most conveniently performed with a calibrated, high accuracy Wheatstone Bridge. To obtain accurate calibration of the instrument, it will be necessary to utilize the bridge correction factors, and to make all measurements in a temperature controlled environment, or where necessary, to correct for temperature-caused errors. When connecting the instrument to the Wheatstone Bridge, some consideration should be given to the resistance of the connecting leads. For maximum accuracy, this resistance can be measured in the same fashion as the zero resistance, and suitable correction made for its magnitude.

3.4 Maintenance

No maintenance should ever be required for the instruments.

3.5 PRIME TECHNOLOGY, INC RECALIBRATION/RECERTIFICATION SERVICE

Prime Technology, Inc. offers a full Recalibration/Recertif-cation Service. Please call us at (203) 481-5721 or FAX us at (203) 481-8937 for more information.



NO OF DIALS	A DIM	B DIM
4	4	17
5	4	17
6	4	17
7	4	17

Figure 1

REVISIONS				
SYM	DESCRIPTION	ECN NO.	DATE	APPD.

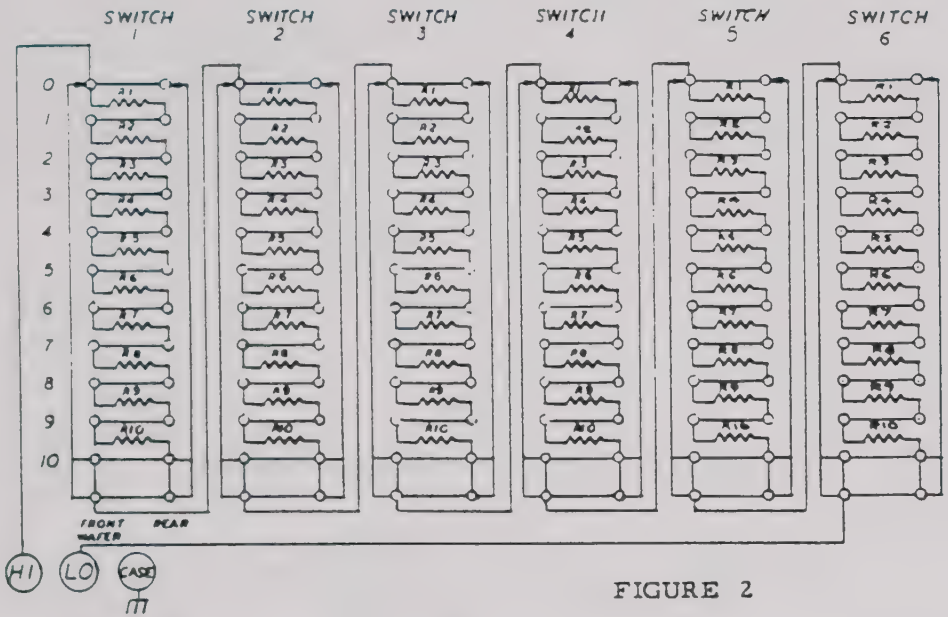


FIGURE 2

NOTE: See Section 1.3 (Specifications) for decade values per unit.

Unit shown is a 6 decade unit or RDS 6 __M. The 4 decade schematic is the same but with 2 less decades, etc.

MATERIAL	DRAWN DATE	GENERAL RESISTANCE, INC.	
	APPD. DATE	TITLE	SCHEMATIC, 6 DIAL RDS
	TOLERANCE		
FINISH	DECIMALS ± .005	SIZE C	DRAWING NUMBER / REV.
	FRACTIONS ± 1/64		
USED ON	ANGLES ± 1/2	SCALE	SHEET OF

Measurement of Zero Resistance and
Decades of One and Ten Ohms Per Step

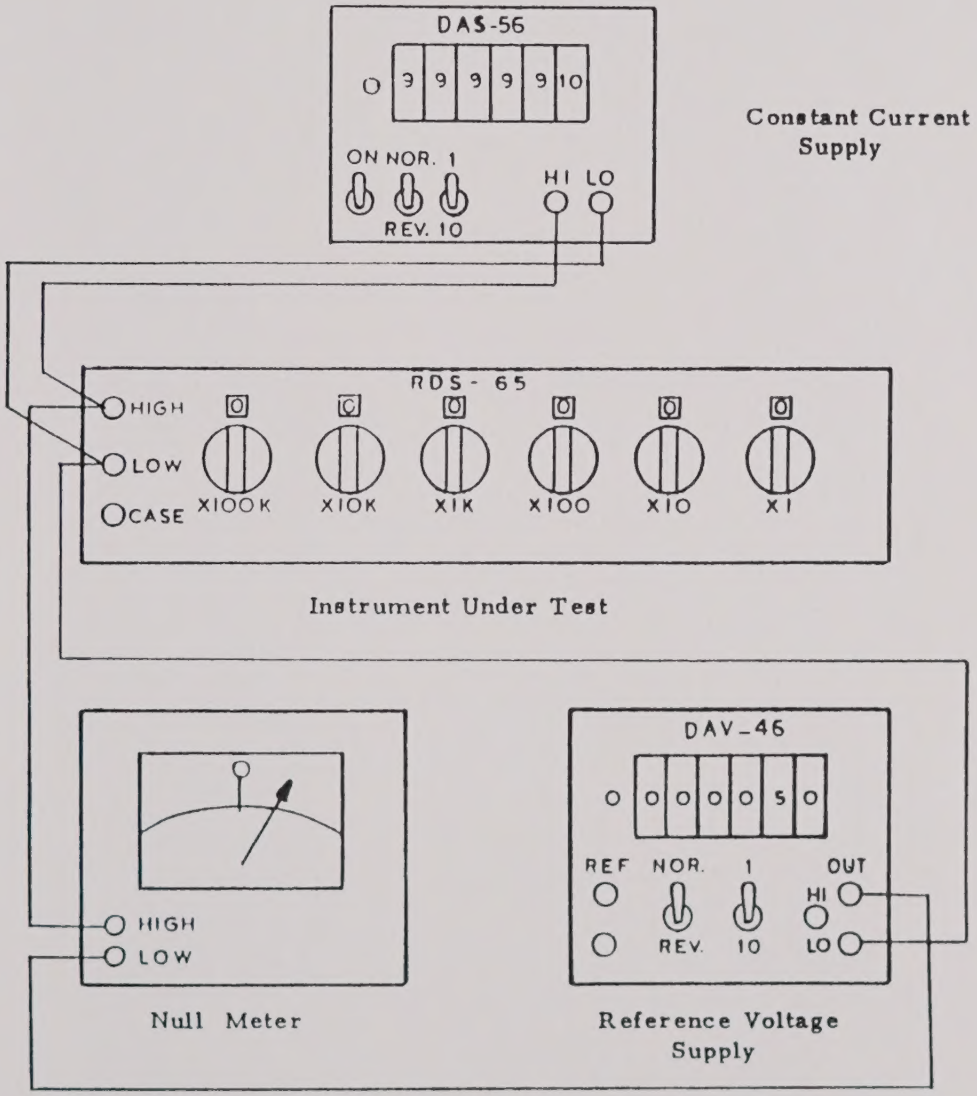


Figure 3